December 15, 1881.

THE PRESIDENT (followed by THE FOREIGN SECRETARY) in the Chair.

The Right Hon. Sir William Vernon Harcourt, whose certificate had been suspended as required by the Statutes, was balloted for and elected a Fellow of the Society.

The Presents received were laid on the table, and thanks ordered for them.

The following letter addressed to the President of the Royal Society was read :—

Institut de France, Paris, 5th of December, 1881.

MY DEAR MR. PRESIDENT,—In the meeting of the Academy of to-day M. Dumas has read a letter from Professor Williamson, informing the Academy that the Copley Medal has been awarded to me. I know well and appreciate highly the value of that reward, and I beg you to offer to the Royal Society my sincere thanks.

That illustrious body honoured me, seventeen years ago, by electing me as one of its foreign members, and now has been pleased to crown my far advanced scientific career.

I beg leave to give to my English colleagues a proof of my respectful regard by presenting to them the first results of new researches on the synthesis of oxygenated bases. By the reaction of glycol-chlorhydrine on collidine and on quinoline I have obtained new alkaloids, which present a close connexion with neurine. Very soon I intend to send over to Professor Williamson a paper on that subject.

I am, with the highest regards,
Sincerely yours,
AD. WURTZ,
President of the Académie des Sciences.

The following Papers were read :—

I. "On the Electromotive Properties of the Leaf of Dionæa in the Excited and Unexcited States." By J. BURDON SANDERSON, M.D., F.R.S., &c. Received October 27, 1881.

(Abstract.)

The paper consists of five parts. Part I is occupied by the examination of two experimental researches, relating to the subject, which

have been published in Germany since the date of the author's first communication to the Royal Society in 1873,* namely, that of Professor Munk on Dionæa, and of Dr. Kunkel on electromotive action in the living organs of plants. According to Dr. Munk, the electric properties of the leaf may be explained on the theory that each cylindrical cell of its parenchyma is an electromotor, of which the middle is, in the unexcited state, negative to the ends, and that on excitation the electromotive forces of the cells of the upper layer undergo diminution, those of the lower layer an increase. He accounts for the diphasic character of the electrical disturbance which follows mechanical excitation by attributing it to the opposite electromotive reactions of the two layers of cells. According to this theory, the cells resemble in their properties the "electromotive muscle-molecules" ("Untersuchungen," vol. i, p. 682, 1848, of du Bois Reymond) differing from them in so far that their poles are positive instead of being negative to their equatorial zones. Professor Munk has constructed a schematic leaf in which the cells are represented by zinc cylinders with copper zones. A schema so made is said by him to have the electromotive properties of the unexcited leaf.

Dr. Kunkel's experiments have for their purpose to show that all the electromotive phenomena of plants may be explained as consequences of the movement of water in the organs at the surfaces of which they manifest themselves.

Part II contains a description of the apparatus and methods used in the present investigation.

In Part III are given the experimental results relating to the electromotive properties in the unexcited state, a subject of which the discussion was deferred in the paper communicated by the author (with Mr. Page) in 1876.† The fundamental fact relating to the distribution of electrical tension on the surface of the leaf when in the unexcited state is found to be that (whatever may be the previous electrical relation between the two surfaces) the upper surface becomes after one or two excitations negative to the under, and remains so for some time. This difference of potential between the two surfaces the author calls the "cross difference." It is shown that, under the conditions stated, its occurrence is constant, and that the differences of potential which present themselves when other points of the surface of the leaf are compared, may be explained as derived from, or dependent on, this fundamental difference.

Part IV relates to the immediate electrical results of excitation, *i.e.*, to the electrical phenomena of the excitatory process. In investigating these the author takes as the point of departure, an experiment which includes and serves to explain those obtained by other methods, and

* "Proceedings," vol. 21, p. 495.

† "Proceedings," vol. 25, p. 411.

is therefore termed the "fundamental experiment." It consists in measuring the successive differences of potential (cross differences) which present themselves between two opposite points on the upper and on the under surface of one lobe of the leaf, during periods which precede, include, and follow the moment at which the opposite lobe is mechanically or electrically excited. In this experiment it is found that, provided that the conditions are favourable to the vigour of the leaf, the variations of the cross difference (called the excitatory variation) occur in the following order:—

Before excitation (particularly if the leaf has been previously excited).	*Upper* surface negative to under.
At the moment of excitation.	Sudden negativity of *under* surface, attaining its maximum in about half a second, when the difference amounts to not less than $\frac{1}{15}$ Daniell.
After excitation.	Rapidly increasing negativity of the *upper* surface, beginning about 1·5″ and culminating about 3″ after excitation, and slowly subsiding.

This subsidence is not complete, for, as has been said, the lasting difference between the two surfaces is augmented—the upper surface becoming more negative after each excitation ("after-effect").

When by a similar method two points are taken for comparison on opposite lobes, the phenomena are more complicated, but admit of being explained as resulting from the more simple case above stated, in which only a few strata of cells are interposed between the leading off electrodes.

In Part V the relation of the leaf to different modes of excitation is investigated. As regards electrical excitation the results are as follows:—If a voltaic current is led across one lobe by non-polarisable electrodes applied to opposite surfaces (the other lobe being led off as in the fundamental experiment) a response (excitatory variation) occurs at the moment that the current is closed, provided that the strength of the current is adequate, and not much more than adequate. No response occurs at breaking the current. When a current of more than adequate strength is used, and its direction is downwards, the response at closing is followed by several others. This effect does not happen when the current is directed upwards. To evoke a response a current must be much stronger if directed upwards than if directed downwards through the same electrodes. Weak currents cease to act when their duration is reduced to $\frac{1}{100}$″; for stronger ones the limit is

shorter. Inadequate currents, if directed downwards, produce negativity of the upper surface, which lasts for several seconds after the current is broken. This effect is limited to the surfaces through which the current is led. Its direction shows it is not dependent on polarisation. By opening induction currents, if their strength does not much exceed the limit of adequacy, a leaf may be excited at intervals for several hours without failure. Weaker currents are more effectual when directed downwards than when directed upwards. If two inadequate induction currents follow one another at any interval less than $0''\cdot4$ and greater than $0''\cdot02$, they may evoke a response. In this case a response follows the second excitation. When a leaf is subjected to a series of induction currents at short intervals ($\frac{1}{20}''$) the response occurs after a greater or less number of excitations. If the temperature is gradually diminished, the number is increased by each diminution. All of the above statements relating to excitability refer to plants kept in a moist atmosphere at 32—35° C.

From the preceding facts, and others which are stated in the paper, the author infers (1) that the "cross difference" is the expression of electromotive forces which have their seat in the living protoplasm of the parenchyma cells, and that it is due to the contact of cells in different states of physiological activity; (2) that the second phase of the excitatory variation is probably dependent on the diminution of turgor of the excited cells, and therefore on the migration of liquid; (3) but that no such explanation can possibly be accepted of the phenomena of the first phase, the time relations of which, particularly its sudden accession and rapid propagation, show it to be the analogue of the "negative variation" or "action current" of animal physiology.

II. "On some Effects of Transmitting Electric Currents through Magnetised Electrolytes." By Dr. G. Gore, F.R.S. Received November 29, 1881.

(Abstract.)

This communication treats of a class of electro-magnetic rotations observed and examined by the author. The rotations are produced in liquids by means of axial electric currents, either in the interior of vertical magnets, electro or permanent, or near the poles of such magnets, and differ from rotations previously produced in liquids placed in those positions, by the absence of radial currents, to the